ADDENDUM

TO THE

PUBLIC REVIEW DRAFT OF THE HALIBUT CHARTER GHL ANALYSIS

This addendum contains the following changes to the halibut charter GHL analysis:

Part I. adds a suboption to Issue 3, Option 2, Suboption 2:
"or an amount proportionate to the reduction in abundance (indicated by the CEY)"

Part II. updates Section 3.1 to incorporate new biological information from the IPHC 1999 halibut stock assessment

Part III. updates Section 6.3 by providing additional information from agency staff on implementation and enforcement issues.
- it includes a proposal to add temporal adjustments to bag limits to the list of management measures

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February 1, 2000

PART 1: ERRATA, ISSUE 3, OPTION 2, SUBOPTION 2 (p. 197)

ISSUE 3: Under varying halibut abundance.

Option 1: Status quo. The GHL fixed percentage varies on an annual basis with area halibut abundance.

Option 2: Reduce area-specific GHL ranges during years of significant stock decline. The following suboptions may be instituted in a stepwise fashion, and/or used in combination.

Suboption 1: Reduce to 75-100% of base year amount when the charter allocation is predicted to exceed a specified percentage (options: 15, 20, or 25%) of the combined commercial and charter TAC.

Suboption 2: Reduce area-specific GHL by a set percentage (options: 10, 15 or 20%). The trigger for implementing the reduction would be based on total harvests and would be IPHC area-specific:

Area 2C Options	Area 3A Options
4 million lb	10 million lb
6 million lb	15 million lb
8 million lb	20 million lb

or an amount proportionate to the reduction in abundance (indicated by the CEY)

The bolded text above was added to the trigger levels under Issue 3, Option 2, Suboption 2 but was inadvertantly omitted from the public review draft. The language was approved by the Council during its deliberations in December 1999. The intent of the additional trigger level is to link a proportionate reduction of an area-specific GHL range with that of the area-specific CEY determined in the IPHC halibut stock assessment. Staff interprets the time frame to be from one year to the next, i.e, compare the 2001 CEY to the 2000 CEY and adjust the range of fish proportionate to that change in CEY, if the change was negative. A positive change in CEYs would not result in a proportionate increase in the range of fish.

Under this suboption, the GHL range of fish would be adjusted by the decline in CEY. Historical CEYs are presented in Table 1; however, the 1999 CEY reflects the IPHC's current understanding of stock abundance and recruitment. The Area 2C total CEY was reduced by 34% between 1999 and 2000. The Area 3A total CEY was reduced by 40%.

To illustrate its effectiveness, a proportionate reduction to the range of fish by area would be:

For Area 2C, the fixed range of fish associated with the 1995 base year (50 - 62 thousand fish) would be reduced to 33 - 41 thousand fish. This compares to 38 - 50 thousand fish when the combined charter and commercial quota was 6.97 M lb under the 15% suboption, 4.92 M lb under the 20% suboption, and 3.69 M lb under the 25% suboption.

For the 1998 base year, the fixed range of fish associated with the Area 2C 1995 base year (61 - 76 thousand fish) would be reduced 40 - 50 thousand fish. This compares to 46 - 61 thousand fish when the combined charter and commercial quota was 12.52 M lb under the 15% suboption, 8.84M lb under the 20% suboption, and 6.63 M lb under the 25% suboption. A broader discussion of of Suboption 2 is found on p.197 of the public review draft of the GHL analysis.

For Area 3A, the fixed range of fish associated with the 1995 base year (138 - 172 thousand fish) would be reduced to 83 - 103 thousand fish. This compares to 104 - 138 thousand fish when the combined charter and commercial quota was 5.61 M lb under the 15% suboption, 3.96 M lb under the 20% suboption, and 9 3.6 M lb under the 25% suboption.

For the Area 3A 1998 base year, the fixed range of fish associated with the 1995 base year (155 - 193 thousand fish) would be reduced to 93 - 116 thousand fish. This compares to 116 - 155 thousand fish when the combined charter and commercial quota was 10.01 M lb under the 15% suboption, 7.07 M lb under the 20% suboption, and 5.30 M lb under the 25% suboption. A broader discussion of of Suboption 2 is on p.198.

Table 1A. **Estimated setline CEY, staff recommended catch limits, and catch limits of Pacific halibut by IPHC regulatory area (in thousands of pounds, net weight), 1993 - 1999.**

Regulatory	**Estimated Setline CEY**						
Area	1993	1994[1]	1995[2]	1996	1997	1998	1999
2A	460	490	520		930	1,050	690
2B	9,810	8,320	9,520		15,990	15,380	11,210
2C	10,410	12,660	8,540	Skipped	11,410	15,480	10,490
3A	23,130	27,020	16,870	Between	33,550	38,710	24,670
3B	4,070	3,580	3,660	Models	11,490	30,990	26,830
4A						11,110	8,420
4B	Area 4	Area 4 =	Area 4 =		Area 4 =	10,210	6,710
4CDE	5,590	5,000	5,920		25,290	13,280	9,800
Total	53,470	57,070	45,030		98,660	136,210	98,820
Regulatory	**Staff Recommendation**						
Area	1993	1994	1995	1996	1997	1998	1999
2A	460	500	450	520	700	820	690
2B	9,810	9,500	8,500	9,520	12,500	13,460	11,210
2C	10,410	12,000	8,500	9,000	10,000	11,800	10,490
3A	23,130	26,000	20,000	20,000	25,000	29,570	24,670
3B	4,070	4,000	3,700	3,700	9,000	16,300	13,370
4A	2,020	1,800	2,000	1,950	3,000	5,640	4,240
4B	2,020	2,100	1,600	2,310	3,200	5,700	3,980
4CDE	1,520	1,500	2,300	1,660	2,800	3,000	4,130
Total	53,440	57,400	47,050	48,660	66,200	86,290	72,780
Regulatory	**Catch Limits**						
Area	1993	1994	1995	1996	1997	1998	1999
2A	600	550	520	520	700	820	760
2B	10,500	10,000	9,520	9,520	12,500	13,000	12,100
2C	10,000	11,000	9,000	9,000	10,000	10,500	10,490
3A	20,700	26,000	20,000	20,000	25,000	26,000	24,670
3B	6,500	4,000	3,700	3,700	9,000	11,000	13,370
4A	2,020	1,800	1,950	1,950	2,940	3,500	4,240
4B	2,300	2,100	2,310	2,310	3,480	3,500	3,980
4CDE	1,720	1,500	1,660	1,660	2,580	3,500	4,450
Total	54,340	56,950	48,660	48,660	66,200	71,820	74,060

[1] Average of standard and alternative (conservative) assessments
[2] From 1995 on, CEY based on projected rather than lagged ebio

PART II: REVISED SECTION 3.1, IPHC UPDATE (p. 30)

The proposed alternatives in this analysis address an allocation of halibut between the commercial fixed gear and recreational charter sectors. The two main criteria that determine if and when the GHLs, as presented in this analysis, will be reached or exceeded are:(1) the status of the halibut biomass and future biomass projections, and (2) charter effort and projected growth of harvest. This section provides the baseline data from the IPHC halibut stock assessment and descriptions of halibut harvests and participation by fishery sector and area that are used in Sections 4 - 6 to prepare the RIR. Lastly, halibut biomass and charter fishery projections as presented to the Council in 1993 and 1997, from the 1999 IPHC stock assessment and as currently updated for the 2000 fishing year, are discussed.

3.1 Biology and total removals of Pacific halibut in Areas 2C and 3A

3.1.1 Method of Quota Calculation (from Clark and Parma 1998, 1999)

The halibut resource is healthy and total removals were at record levels in 1999, which ranked in the top five highest years at over 98 million lb (Table 3.1). Record high sport fisheries occurred in 1998 and commercial fisheries in 1999. The 1998 and 1999 total removals of halibut off the Pacific coast for all areas by commercial catch, sport harvest, bycatch mortality, personal use and wastage that were used by the IPHC in its stock assessment are presented in Figure 3.1.

Table 3.1a. Pacific halibut removals by regulatory area and sector in 1998 (thousand lb net wt.)

Area	2A	2B	2C	3A	3B	4	Total
Commercial	464	13,139	10,228	25,874	11,346	9,150	70,201
Sport	383	657	2,708	5,176	23	61	8,400
Bycatch Mortality:							
Legal-sized fish	381	108	218	1,490	744	3,645	6,586
Sublegal-sized fish	233	135	143	1,362	730	3,915	6,518
Personal Use	15[1]	300	170	74	20	162	741
Wastage:							
Legal-sized fish	3	53	51	155	57	46	365
Sublegal-sized fish	4	378	180	580	290	176	1,608
Total	1,483	14,770	13,698	34,711	13,210	17,155	94,419

Table 3.1b. Pacific halibut removals by regulatory area and sector in 1999 (thousand lb net wt.)

Area	2A	2B	2C	3A	3B	4	Total
Commercial	446	12,732	10,202	25,287	13,873	11,878	74,418
Sport	338	1,582	1,830	5,243	22	108	9,122
Bycatch Mortality:							
Legal-sized fish	380	110	230	1,600	880	3,460	6,660
Sublegal-sized fish	234	94	123	1,287	786	3,712	6,236
Personal Use	15	300	170	74	20	170	734
Wastage:							
Legal-sized fish	6	38	72	101	69	107	393
Sublegal-sized fish	2	330	162	421	253	155	1,323
Total	1,421	15,186	12,789	34,013	15,903	19,590	98,886

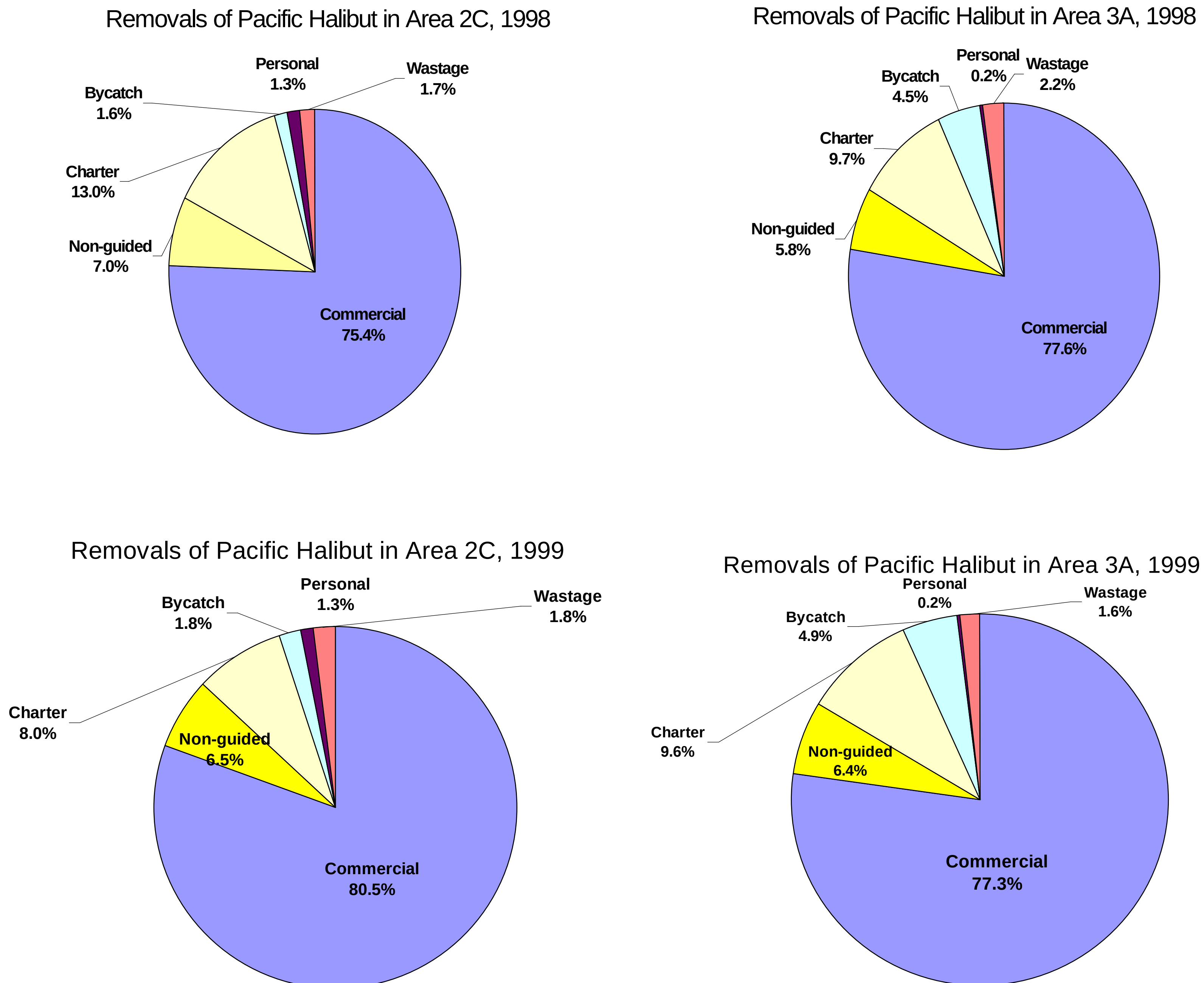

Figure 3.1. Pacific halibut removals in Areas 2C and 3A, 1998-99.

Each year the IPHC staff assesses the abundance and potential yield of Pacific halibut using all available data from the commercial fishery and scientific surveys. The exploitable biomass (yield) is estimated to set quotas for ten regulatory areas by fitting a detailed population model to the data from that area (Figure 3.2). A biological target level for total removals is then calculated by multiplying a fixed harvest rate—presently 20%—to the estimate of exploitable biomass. This target level is called the "constant exploitation yield" or CEY for that area in the coming year. The CEY therefore changes annually in proportion to the exploitable biomass. Each CEY represents the total allowable harvest (in lb) for that area, which can not be exceeded. The IPHC then estimates the sport and personal use/subsistence harvests and wastage and bycatch mortalities for each area. These are subtracted from the CEY and the remainder may be set as the catch quota for each area's directed commercial setline (longline) fishery. Staff recommendations for quotas in each area are based on the estimates of setline CEY but may be higher or lower depending on a number of statistical, biological, and policy considerations. Similarly, the Commission's final quota decisions are based on the staff's recommendations but may be adjusted for conservation considerations.

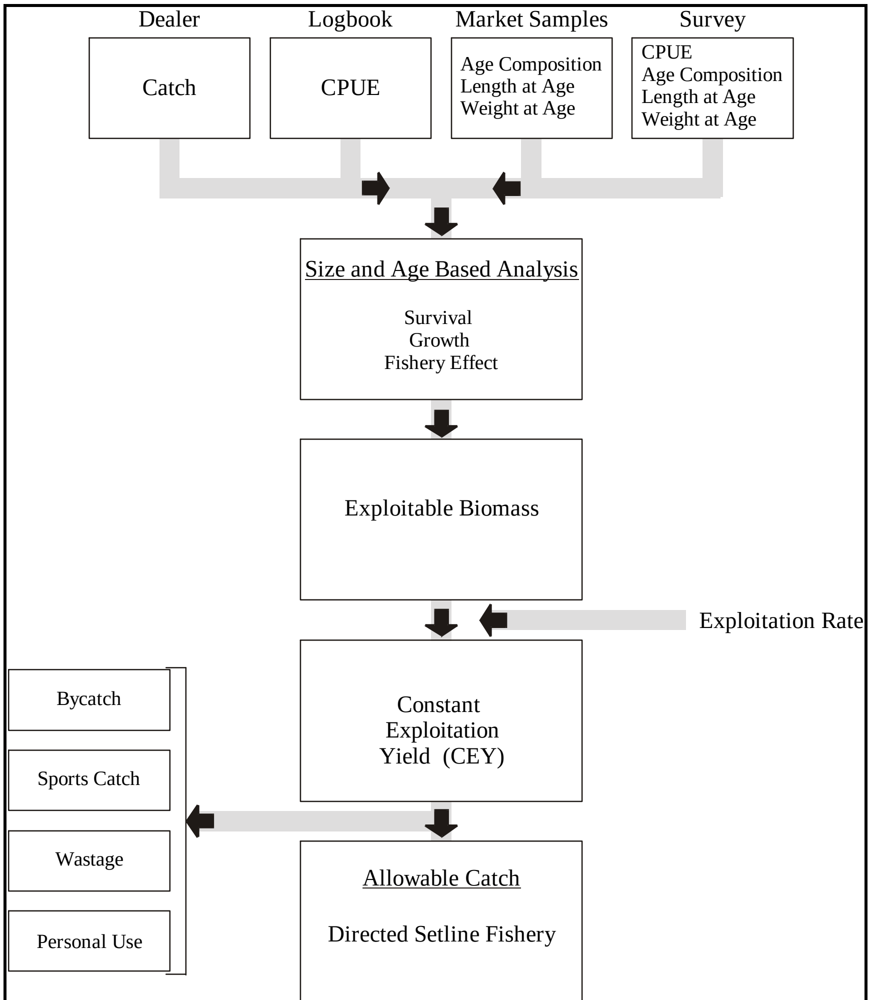

Figure 3.2 Overview of IPHC Pacific halibut stock assessment.

From 1982 through 1994, stock size was estimated by fitting an age-structured model (CAGEAN) to commercial catch-at-age and catch-per effort data. In the early 1990s it became apparent that age-specific selectivity in the commercial fishery had shifted as a result of a decline in halibut growth rates, which was more dramatic in Alaska than in Canada. An age- and length-structured model was developed and implemented in 1995 that that accounted for the change in growth. It also incorporated survey (as well as commercial) catch-at-age and catch-per effort data. The survey data contain much more information on younger fish, many of which are now smaller than the commercial size limit, and are standardized to provide a consistent index of relative abundance over time and among areas.

At first the model was fitted on the assumption that survey catchability and length-specific survey selectivity were constant, while commercial catchability and selectivity were allowed to vary over time (subject to some restraints). The resulting fits showed quite different length-specific survey selectivities in Area 2B and 3A, however, which suggested that age could still be influencing selectivity. To reflect that possibility, the new model has been fitted in two ways since 1996: by requiring constant length-specific survey selectivity (as in 1995), and by requiring constant age-specific survey selectivity. The age-specific fits generally produce lower estimates of recent recruitment and therefore present abundance, and to be conservative the staff has used those estimates to calculate CEY's.

With either fitting criterion, the abundance estimates depend strongly on the natural mortality rate M used in the population model. Until 1998, the estimate $M = 0.20$ had been used in all assessments. This estimate is quite imprecise, and an analysis done by the staff suggested that a lower working value would be appropriate. The value $M = 0.15$ was chosen and used as a standard, which lowered abundance estimates in the 1998 assessment by about 30%.

The only significant change to the assessment in 1999 was introducing an increase in setline survey catchability, beginning with the 1993 survey data, to account for a change in bait between the 1980s and the 1990s. When setline surveys resumed in 1993 (after being suspended since 1986), chum salmon was adopted as the standard bait, whereas in the 1980s the bait was herring and salmon on alternate hooks. Experiments done within the last year showed that salmon bait catches 50-150% more halibut than herring. Further experiments are planned for this summer in which mixed bait will be compared directly with salmon. In the meantime, a working value of 100% was used in the assessment. This translates to a 33% increase in overall survey catchability after the 1980s. (For every two hooks, in terms of hooks baited with salmon, the survey switched from the equivalent of 1½ hooks to 2 hooks, an increase of one third.).

Increasing survey catchability by 35% in the 1990s to account for the bait change has the effect of reducing the apparent increase in halibut abundance since the 1980s by 25%, but it does not reduce the estimates of 1999 biomass by the same amount because other things play a role, including commercial catch per effort. As a result, the estimate for 1999 for Area 2C decreased by about 20% and for Area 3A decreased by almost 30%.

The addition of the 1999 commercial data can affect the 1999 estimates through the commercial CPUE, the age composition of the catch, and the mean weight at age in the catch. The only sizable effect was a large decrease in the Area 3A estimate caused almost entirely by an ongoing decline in the mean weights. It appeared to have leveled off in the mid-1990s, but it has resumed in Areas 2C and 3A since 1997, reducing biomass estimates in Alaska by a full 20% over the last two years.

When the estimated numbers at age are projected forward to 2000 (using the 1999 mean weights to calculate biomass), the change in the biomass estimate depends on the estimated abundance of all the year-classes in the stock, which at ages 8 to 20 in 2000 will be the 1980 through 1992 year-classes. Generally the year-classes coming into the stock are now weaker than the ones passing out of it, so the projections for 2000 are lower than the 1999 estimates. The drop is bigger in 3A (20%) than in Area 2C (10%) because the assessment shows that recruitment to 3A peaked in 1980 and has been declining steeply, to levels that are now on a par with the mid-1970s. In Area 2C, the 1987 and 1988 year-classes were strong, and the most recent ones appear to be mediocre but not as poor as in Area 3A.

In summary, this year's estimates are substantially lower than last year's because of the allowance for increased survey catchability, lower mean weights at age, and recent declines in recruitment. A change to the data going into the model for 2000 lowered the setline survey catch rates from the 1990s to account for a bait change, which reduced the population estimates by 20-30% in the eastern and central Gulf of Alaska (Areas 2 and 3A). A continuing decline in size at age also affected the estimates in Area 2C and Area 3A. Very low estimated recruitment in Area 3A in recent years implies a rapidly declining biomass in that area, but trawl surveys indicate continuing high abundance of 60-80 cm fish in that area, so more data is need to verify these estimates. However, it does now appear that recruitment has declined from the high levels of 1985-1995. In Alaska (2C and 3A) the cumulative effect is a 35-40% reduction in biomass.

A review of Pacific halibut biology and biomass can be found in IPHC (1998). Further details on the history of IPHC assessment methods and harvest strategy are given below and in a detailed account of the 1997 assessment (Sullivan et al. 1999) (see box below).

RECENT CHANGES IN IPHC ASSESSMENT METHODS AND HARVEST POLICY

1982-1994: stock size was estimated with CAGEAN, a strictly age-structured model fitted to commercial catch-at-age and catch-per-effort data. Because of a decrease in growth rates between the late 1970s and early 1990s, there were persistent underestimates of incoming recruitment and total stock size in the assessments done in the early 1990s.

Until 1985, allowable removals were calculated as a proportion of estimated annual surplus production (ASP), the remaining production being allocated to stock rebuilding. In 1985 the Commission adopted a constant harvest rate policy, meaning that allowable removals are determined by applying a fixed harvest rate to estimated exploitable biomass. This harvest level is called the Constant Exploitation Yield, or CEY. The fixed harvest rate was set at 28% in 1985, increased to 35% in 1987, and lowered to 30% in 1993.

1995: a new age- and length-structured model was implemented that accounted for the change in growth and was fitted to survey as well as commercial catch-at-age and catch-per-effort data. The new model produced substantially higher biomass estimates. In Area 3A this resulted from accounting for the change in growth schedule. In Area 2B, where the change in growth had been much less than in Alaska, it resulted from fitting the model to survey catch-per-effort, which showed a larger stock increase since the mid-1980s than commercial catch-per-effort. Quotas were held at the 1995 level to allow time for a complete study of the new model and results,

1996: differences in estimated selectivity between British Columbia and Alaska led to the consideration of two alternatives for fitting the model, one in which survey selectivity was a fixed function of age and the other in which it was a function of length. Spawner-recruit estimates from the new model resulted in a lowering of the target harvest rate to 20%. Quotas were increased somewhat, but not to the level indicated by the new biomass estimates.

1997: setline surveys of the entire Commission area indicated substantially more halibut in western Alaska (IPHC Areas 3B and 4) than the analytical assessment. Biomass in those areas was estimated by scaling the analytical estimates of absolute abundance in Areas 2 and 3A by the survey estimate of relative abundance in western Alaska. CEY estimates increased again, and quotas were increased again, but still to a level well below the CEY's.

1998: the working value of natural mortality was lowered from 0.20 to 0.15, reducing analytical estimates of biomass in Areas 2 and 3A by about 30%. At the same time setline survey estimates of abundance in Areas 3B and 4 relative to Areas 2 and 3A increased, so biomass estimates in the western area decreased by a smaller amount.

1999: setline survey catch rates in the 1990s were adjusted downward to account for the effect of changing to all-salmon bait when the surveys resumed in 1993. This reduced biomass estimates by 20-30%.

3.1.2 Current Estimates of exploitable biomass and CEY (from Clark and Parma 1998, 1999 and Gilroy 1999)

The target harvest rate of 20% was chosen on the basis of calculations of stock productivity that used a coastwide average of the estimates of commercial selectivity from the age-specific fit of the model, so the biomass estimates from the age-specific fits are used to calculate exploitable biomass and CEY. Overall the estimated setline CEY is approximately 63 million lb (Table 3.2), down from 99 million lb in 1998 and 136 million lb in 1997.

Table 3.2. Exploitable biomass estimates and catch limit recommendations.

Area	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1999 exploitable biomass (from the 1998 assessment)	5.36	61.64	64.00	159.00	138.33	46.11	34.98	58.83	568.25
1999 Setline CEY (from the 19998 assessment)	0.69	11.21	10.49	24.67	26.83	8.42	6.71	9.80	98.82
1999 quota	0.76	12.10	10.49	24.67	13.37	4.24	3.98	4.45	74.06
2000 exploitable biomass (from the 1999 assessment)	4.44	51.06	42.20	94.90	96.80	36.10	35.10	35.10	395.70
Total CEY at 20%	0.89	10.21	8.44	18.98	19.36	7.22	7.02	7.02	79.14
Non-commercial removals									
Bycatch	0.38	0.11	0.23	1.60	0.88	0.58	0.22	2.83	6.83
Sport catch	0.34	1.58	1.83	5.24	0.02	0.10	0.00	0.01	9.12
Personal use	0.00	0.30	0.00	0.10	0.04	0.08	0.00	0.01	0.53
Wastage	0.01	0.04	0.07	0.10	0.07	0.04	0.04	0.04	0.39
2000 Setline CEY	0.54	8.18	6.31	11.94	18.36	6.42	6.77	4.13	62.65
2000/1999 total CEY	0.83	0.83	0.66	0.60	0.70	0.78	1.00	0.60	0.70
2000/1999 setline CEY	0.79	0.73	0.60	0.48	0.68	0.76	1.01	0.42	0.63

3.1.3 Analytical estimates of abundance in 1999 (from Clark and Parma 1999)

The IPHC stock assessment shows a strong 1987 year-class. The age- and length- based models show a drop in recruitment after that year-class, but these age-groups (ages 8-10 in 1998) are still estimated imprecisely.

Figure 3.3 shows estimated recruitment at age 8 and total biomass of fish aged 8 and older for both models. The two results are very similar in Area 2C and Area 3A until the last few years. An important change from the 1997 assessment is that in 1998 both the age- and length-specific fits in Area 3A show a downturn in recruitment after the 1987 year-class. The 1997 results showed that the length-specific fit indicated recruitment would continue at approximately the level of the 1987 year-class. The change resulted mainly from the screening and heavier weighting of size-at-age data.

Biomass changes in Areas 2C and 3A have occurred as a result of changes to the stock assessment model more than as a result of biological changes. In the absence of model changes, short-term fluctuations in exploitable biomass, and therefore in quotas, should be small.

Recruitment represents a small fraction of the exploitable biomass, and has a small annual effect. Increased selectivity over ages 8- to 12-yrs accounts for the majority of biomass added annually to offset natural mortality. The very large exploitable biomass relative to recruitment buffers the population from changes. However, because exploitable biomass has been at a high level, and because recruitment has declined over the past several years, lower exploitable biomass is more probable than higher exploitable biomass for the next five years.

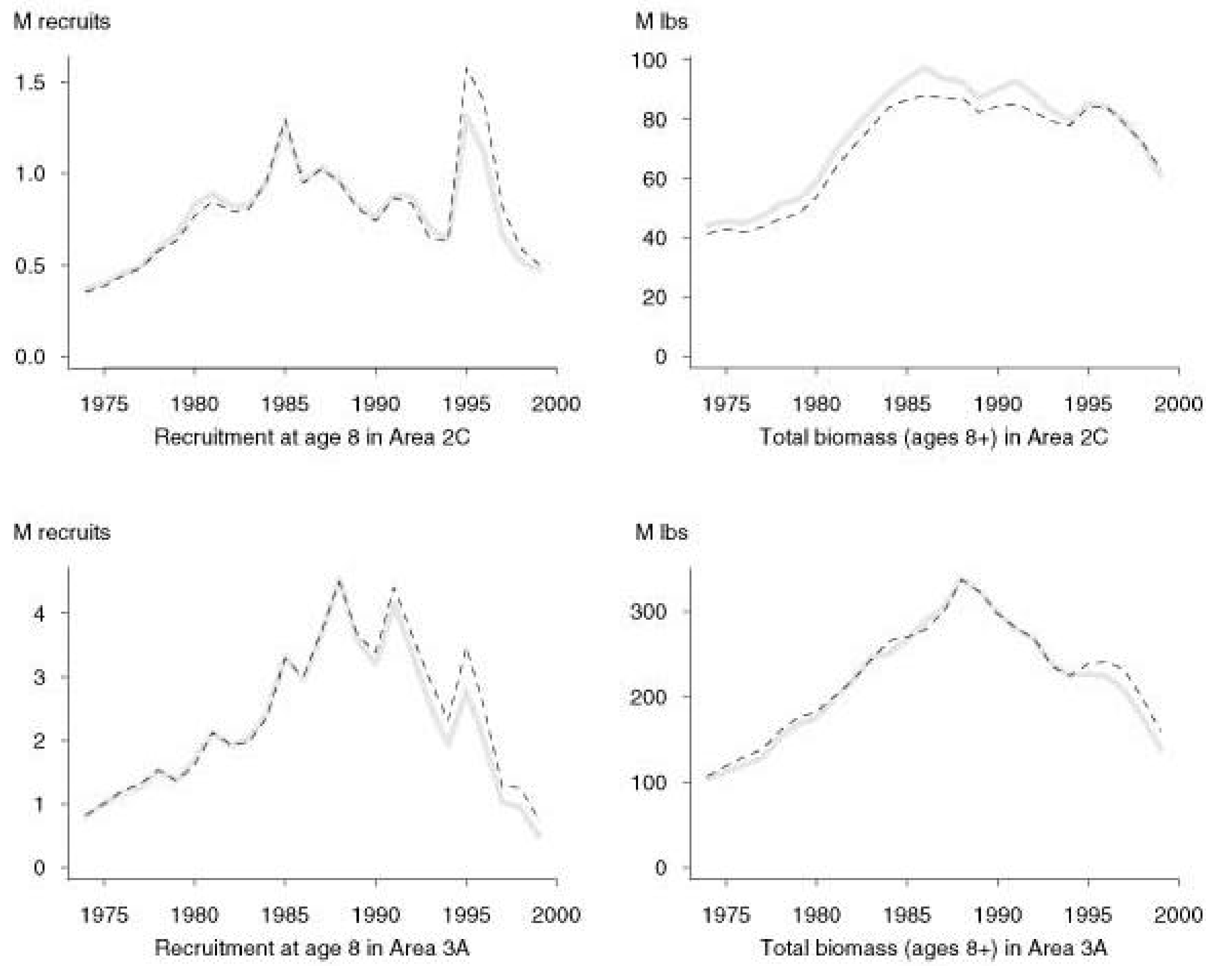

Figure 3.3. IPHC estimates of recruitment (million fish) and total biomass (million net lb) from length and age based models.

3.1.4 Halibut biomass and quotas projections in Areas 2C and 3A (NPFMC 1997, Clark and Parma 1999)

Vincent-Lang and Trumble (1993) jointly reported that the coast-wide exploitable halibut biomass declined by 25% from 359 to 266 million lb during 1988 -92, while the sport harvest increased about 40%. In 1993, exploitable biomass was declining at about 10% per year. During 1993-97, biomass was predicted to continued to decline at annual rates of 9, 7, 5, 3, and 1% per year. Halibut biomass was then predicted to increase from 1998 through 2000 at 1, 3, and 5% per year, respectively, due to increasing recruitment (Table 3.3, labeled '1993 Projections'). Commercial harvests were characterized as a function of declining halibut biomass and increasing sport harvest. The 1999 exploitable biomass was projected in 1993 to be 175 M lb. In 1999, IPHC staff estimated it to be 396 M lb.

Table 3.3. Comparison of 1993 and 1997 projections of exploitable biomass with 1999 IPHC data (millions of lbs).						
	1993 Projections[1]		1997 Projections[2]			1999 Biomass[3]
Year	1993 projections of % biomass change	1993 exploitable biomass projections	1997 expected value	1997 lower bound	1997 higher bound	Actual exploitable biomass
1993	-9	198				456
1994	-7	185				456
1995	-5	175				447
1996	-3	170				454
1997	-1	168				451
1998	1	170	429	295	563	433
1999	3	175	412	270	555	396
2000	5	184	388	260	516	380
2001			363	255	470	365
2002			341	246	436	350
2003			323	233	414	336
2004			311	219	403	323
2005			302	203	402	310
2006			297	189	404	298
2007			293	177	409	286
2008			292	167	416	274

[1]1993 Projections represent exploitable biomass for state of Alaska (Trumble and Vincent-Lang 1993).
[2]1997 Projections represent exploitable biomass for combined Areas 2A, 2B, 2C, 3A, and 3B (NPFMC 1997).
[3]Estimates of actual exploitable biomass based on 1998 IPHC assessment data for combined Areas 2A, 2B, 2C, 3A, and 3B.
[4]Projections represent exploitable biomass reduced by an average 4%.

It now appears likely that coastwide recruitment has declined from the high levels of the 1985-95 period, and size at age is still going down. Thus while abundance in number is still quite high relative to the levels of 1975 or 1980, biomass levels are not as good and the prospect is for a continuing decline as relatively strong year-classes pass out of the stock and relatively weak ones enter (and grow more slowly).

The prospect is worst in Area 3A, but the apparent near-failure of recruitment there may not be real. NMFS trawl surveys indicate a much higher abundance of 8-year-old halibut in Area 3A than the IPHC analytical assessment based on setline data. This is a puzzle, because for legal-sized halibut trawl and setline surveys agree reasonably well on trends in relative abundance, but since 1990 trawl survey catch rates of sublegal halibut have greatly outpaced setline survey catch rates.

Another cause for suspicion is the re-emergence of a retrospective pattern in the Area 3A estimates, with the estimate of exploitable biomass in a given year increasing in each succeeding assessment. This is consistent with an over-estimate of the selectivity of young fish, whose abundance is consequently underestimated initially. The estimate is then corrected in later assessments as the year-class moves through the fishery. In the past this pattern was caused by declining size at age, but size at ages 8 and below has changed very little, so some other factor must be at work. It therefore seems very possible that exploitable biomass in 3A is underestimated and that incoming recruitment will turn out to be no worse in 3A than in 2AB and 2C. But even that would be low by recent standards. Biomass projections for 2000 are predicted to decline by 9% overall, and 14% for Area 2C and 21% for Area 3A. These will likely result in even lower commercial quotas in 2001.

Since the development of the 1993 projections, major changes in our understanding of the status of the halibut stock have occurred. In 1995, a new age- and length-structured model was developed by IPHC to account for an apparent 20% decrease in the length-at-age of halibut. It produced substantially higher biomass estimates. In 1996, revised spawner-recruit estimates resulted in lowering the target harvest rate to 20%. Quotas were increased somewhat, but below the level indicated by the new biomass estimates. In 1997, biomass estimates and quotas increased again, but still well below levels the IPHC model allowed. In 1998, the estimate of natural mortality was lowered from 0.20 to 0.15, reducing biomass estimates in Areas 2 and 3A by about 30%. In 1999, setline survey catch rates in the 1990s were adjusted downward to account for the effect of changing to all-salmon bait when the surveys resumed in 1993, which reduced biomass estimates by 20-30%.

In 1997, Council staff prepared an analysis that differed from the 1993 reports in its projections of future halibut biomass. The 1997 Council analysis projected that, using an overall exploitation rate of 18% in 1998 and 20% every year thereafter, the expected halibut biomass would decrease by 32% between 1998 and 2008, from an estimated 429 to 292 million lb for the combined Areas 2A-3B.

The stock recruitment model used to generate the projections allowed for a great deal of unpredictable variability induced by the environment; thus, the projections had very wide confidence intervals. Regardless, they represented a substantially slower decline in exploitable halibut biomass than originally estimated in the 1993 report. The coastwide schedule used in the 1980s and early 1990s had higher selectivity-at-age among the younger age groups and so would produce higher estimates of exploitable biomass if applied to the present estimates of numbers-at-age (Clark, pers. commun.).

The projections of exploitable halibut biomass made in 1993 (Vincent-Lang and Trumble) and 1997 (NPFMC) are compared with actual levels in 1994-99 (Table 3.3). Estimates of exploitable biomass from the 1999 IPHC assessment are calculated using the coastwide fixed selectivity schedule which was adopted in 1996. Actual levels appear to fall within the projected range for 1997 and 1998 from the 1997 Council analysis. In fact, the actual 1999 exploitable biomass level (396 M lb) is only slightly below its expected value (412 M lb) from the 1997 projections, but is considerably higher than predicted in 1993 (175 M lb).

Over the last 20 years halibut growth and recruitment rates in Alaska have varied widely, apparently because of changes in the environment rather than any effects of fishing. As a result, projections incorporating a reasonable range of values for growth and recruitment success always diverge rapidly from estimates of present stock size, in both directions. The IPHC staff has calculated such projections from time to time for the purpose of evaluating the robustness of alternative harvest rates, but it does not do so routinely because the projections are so variable (Clark, pers. commun. 1999).

Recruitment represents a small fraction of the exploitable biomass and has a small annual effect. Increased selectivity over ages 8- to 12-yrs accounts for the majority of biomass added annually to offset natural mortality. The very large exploitable biomass relative to recruitment buffers the population from changes. However, because exploitable biomass has been at a high level, and because recruitment has declined over the past several years, lower exploitable biomass is more probable than higher exploitable biomass for the next five years.

Exploitable biomass in Areas 2C and 3A are predicted to decline by 14% and 21% respectively between 1999 and 2000. Applying those rates of decline over the next five years, would predict that Area 2C may be as low as 35 M lb by 2003 and Area 3 may be as low as 62 M lb (Figure 3.4). There is no scientific justification to extend next year's projected decline out for five years, it was done to illustrate the range of potential future exploitable biomasses for Areas 2C and 3A based on the information that is currently available. Therefore, the 1997 analysis projections continue to appear appropriate for estimating future exploitable biomass levels in the near term.

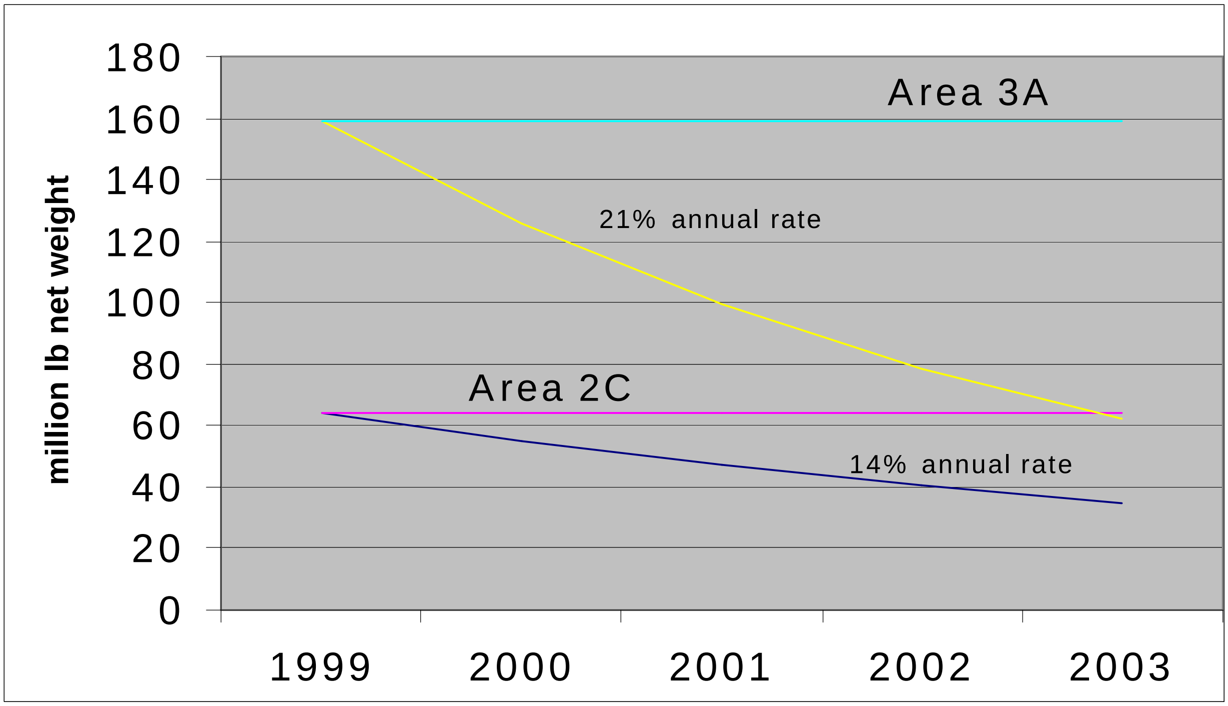

Figure 3.4 Five year projected biomass scenarios under constant and declining assumptions. (14% decline for Area 2C and 21% decline for Area 3A).

<u>Summary</u>

The halibut resource is healthy and total removals are at record levels, however, recruitment and biomass have peaked. Changes for Areas 2C and 3A over the past several years occurred as a result of changes to the stock assessment model more than as a result of biological changes. The Area 2C quota was set at 8.4 M lb, down from 10.5 M lb in 1999. The 2000 Area 3A quotas was set at 18.3 M lb, down from 24.7 M lb in 1999 (Table 3.4). Quotas should not change appreciably over the next few years (Clark and Parma 1999).

Halibut harvests in 1998 in Area 2C totaled 13.0% and 75% of total removals for the charter and commercial fisheries, respectively. In 1999, charter harvest was 8.0% and commercial harvest was 81%. In Area 3A, those fisheries harvested 9.7% and 78%, respectively, in 1998 and 9.6% and 77% in 1999. Non-guided sport halibut anglers harvested 7.0% in 1998 and 6.5% in 1999 in Area 2C and 5.8% in 1998 and 6.4% in 1999 in Area 3A.

The 1997 projections of halibut exploitable biomass appear to accurately reflect current levels. It would be appropriate to continue to apply those projections in the short term.

Lastly, to illustrate the effect of declining size at age, assume the Council set the GHL at 12% in numbers of fish set during a period of peak halibut abundance (either 1995 or 1998 base year). Further assume that the average weight in the charter catch is about the same as the average weight in the commercial catch. During the mid to late 1990's, commercial catches have averaged about 1 million fish. At 12%, the charter fleet would be awarded 136,000 fish (136,000/(1,000,000 + 136,000)) = 12% to take in perpetuity. Over the past few years, the average weight of fish ages 10-15 (which constitute the bulk of the catch) is around 25 pounds. In the mid-1970s, the average weight was slightly greater than 50 pounds. Should a return occur to low productivities that were seen in the mid 1970s and with commercial quotas at around 10 million lb (200,000 fish), it is possible that the charter fleet, having been awarded 136,000 fish (using a 1995 base year) would then be allocated 68% of the combined charter/commercial quota.

Table 3.4. Total removals of Pacific halibut (thousands of pounds, net weight) in IPHC Areas 2C and 3A.

		Area 2C									**Area 3A**						
	Catch Limit	**Comm. Catch**	**Legal-Size Bycatch**	**Sport**	***Charter***	***Non-ch***	**Wasteage**	**Personal Use**	**TOTAL**	**Catch Limit**	**Comm. Catch**	**Legal-Size Bycatch**	**Sport**	***Charter***	***Non-ch***	**Wasteage**	**Personal Use**
1977		3,190	410	72			n/a	n/a	3,672		8,640	3,370	196			n/a	n/a
1978		4,320	210	82			n/a	n/a	4,612		10,300	2,440	282			n/a	n/a
1979		4,530	640	174			n/a	n/a	5,344		11,340	4,490	365			n/a	n/a
1980		3,240	420	332			n/a	n/a	3,992		11,970	4,930	488			n/a	n/a
1981	3,400	4,010	400	318			n/a	n/a	4,728	13,000	14,220	3,990	751			n/a	n/a
1982	3,400	3,500	200	489			n/a	n/a	4,189	14,000	13,530	3,200	716			n/a	n/a
1983	3,400	6,400	200	553			n/a	n/a	7,153	14,000	14,110	2,080	945			n/a	n/a
1984	5,700	5,850	210	621			n/a	n/a	6,681	18,000	19,970	1,510	1,026			n/a	n/a
1985	9,000	9,210	200	682			n/a	n/a	10,092	23,000	20,850	800	1,210			n/a	n/a
1986	11,200	10,610	200	730			n/a	n/a	11,540	28,100	32,790	670	1,908			n/a	n/a
1987	11,500	10,680	200	780			528	n/a	12,188	31,000	31,320	1,590	1,989			2,130	n/a
1988	11,500	11,370	200	1,076			377	n/a	13,023	36,000	37,860	2,130	3,264			2,171	n/a
1989	9,500	9,530	200	1,559			346	n/a	11,635	31,000	33,730	1,800	3,005			2,062	n/a
1990	8,000	9,730	680	1,330			474	n/a	12,214	31,000	28,850	2,630	3,638			1,618	960
1991	7,400	8,690	550	1,654			477	720	12,091	26,600	22,860	3,130	4,264			1,886	490
1992	10,000	9,820	570	1,668			392	370	12,820	26,600	26,780	2,640	3,899			1,513	328
1993	10,000	11,290	330	1,811			361	108	13,900	20,700	22,740	1,920	5,265			1,080	328
1994	11,000	10,380	400	1,986	*986*	*1,000*	384	108	15,244	26,000	24,840	2,350	4,511	*2,553*	*1,958*	1,652	328
1995	9,000	7,760	240	1,751	*986*	*765*	129	n/a	11,631	20,000	18,340	1,570	4,501	*2,839*	*1,662*	539	97
1996	9,000	8,800	230	1,651	*936*	*715*	186	n/a	12,518	20,000	19,690	1,400	4,825	*2,885*	*1,940*	587	97
1997	10,000	9,890	240	1,712	*852*	*860*	183	n/a	13,737	25,000	24,680	1,550	5,641	*3,512*	*2,129*	744	97
1998	10,500	10,230	220	2,708	*1,767*	*941*	231	170	12,720	26,000	25,870	1,490	5,176	*3,238*	*1,938*	735	74
1999	10,490	10,202	233	1,920	*1,060*	*860*	234	170	12,759	24,670	25,287	1,595	5,242	*3,152*	*2,090*	522	74
2000	8,400									18,310							

Source: IPHC and ADF&G (1994-99 sport harvest)

PART III: SECTION 6.3, IMPLEMENTATION AND ENFORCEMENT (p. 200)

Implementation Strategies

It is essential that the Council adopt a strategy that is implementable and cost effective, allows for the use of the best available information, and provides for adaptability. Three significant questions exist with regard to implementation of any Halibut Charterboat GHL option currently under consideration by the NPFMC. These are:

(1) What information will be used to assess harvest?
(2) How will specific management measures be selected and implemented?
(3) How should the management objective for harvest be stated?

Harvest Estimation: At the present time, several data collection programs are fielded by the Alaska Department of Fish and Game to assess charter fishery performance including:

1. *Statewide Mail Survey*. This mail survey is used to estimate sport fishing and harvest on a statewide basis. Within these estimates are estimates of the charter and non-charter recreational harvest and release of halibut.

2. *Statewide Guide Registration.* This statewide registration program is used to track the number of sport fishing guides and guide business that are operating in Alaska's fresh and marine waters annually. Within this database are the number of businesses and guides that target halibut.

3. *Statewide Marine Logbook.* This logbook provides estimates of recreational effort and harvest on marine charters operating off the coast of Alaska. Included are estimates of halibut harvests and participation by charters in the halibut fishery.

4. *Port Sampling.* This program provides estimates of the average size and age of the recreationally caught halibut in the major ports of landing in Areas 2c and 3A.

5. *Creel Surveys.* The Division uses creel surveys in select areas to estimate recreational effort and harvest. One such survey is used to estimate king salmon harvest in southeast Alaska. This survey also provides partial estimates of halibut harvest. Similar surveys are used selectively in southcentral Alaska and provide partial estimates of halibut harvest.

Each of these programs has strengths and limitations. Creel surveys provide valuable first hand observations of the fishery but they are very expensive and lack full geographical coverage. Port sampling provides biological information and important fishery statistics including areas of landings and fishing effort. but is expensive and does little to help assess total area harvest. The Department's charter logbook program shows great promise but this is a very new program and the need still exists to build a longer time series of data, ground truth it, and evaluate the accuracy of the estimates. The Statewide Mail Survey, a postseason survey, is a long time series data set that provides excellent geographical coverage, is reasonably accurate and cost effective but the estimates of harvest are not available for up to one year after the fishing season in question. In total, the Alaska Department of Fish and Game currently spends about $300,000 to $350,000 annually in these programs to collect information on the halibut sport fishery.

Because no specific management program has been in effect for the halibut charter fishery, it should be recognized that none of these assessment programs have demonstrated utility under the allocation/management options under consideration. Until such time as each tool's utility is proven, it will be necessary for harvest estimates to be based on an aggregation of the best available information.

Management measure selection: The Council has identified 11 management measures which could be used to adjust harvest in an effort to maintain the charter fishery within the allocation provided under a GHL or other harvest allocation plan. These are: line limits, boat limits, annual angler limits, vessel trip limits, bag limits, super-exclusive registration, sport catcher vessel only areas, sport fish reserves, rod permits, possession limits, and restrictions on retention of halibut by skipper and crew.

One additional measure involves temporally adjusting bag limits pre-season. This option was not considered in the public review draft EA/RIR/IFRA distributed on January 10, 2000. It was generally discussed by the Council during their deliberations of this issue and is being recommended by the state as another management option for Council consideration. Based on the ADFG logbook program, it is estimated that enactment of a one fish bag limit during specific periods of the open season could potentially reduce harvest 1% to 45% in Areas 2C and 3A (Table 6.18). Smaller reductions would be realized by limiting the bag limit to 1 during May and June with larger reductions being realized by limiting the bag limit to 1 during the peak months (June, July, or August) of the fishery (Figures 6.5 and 6.6). A total season restriction of the bag limit to 1 would reduce harvest by about 40% in Area 2C and 45% in Area 3A.

Table 6.18. Estimated percentage of total harvest reduction by month obtained by implementing a 1-fish bag limit in Areas 2C and 3A during 1998 and 1999.

Area	Month	1998	1999
2C	May	2	1
	June	12	10
	July	14	14
	August	10	14
	September	1	1
	Total	39	40
3A	May	5	4
	June	14	13
	July	17	16
	August	7	10
	September	1	2
	Total	44	45

Each of the above management measures will have a different and unique effect on harvest potential. Additonal information is provided for different levels of line limits in Table 6.19.This effect will likely vary from area to area and will be influenced by changes in stock abundance. Each tool must be continually evaluated in context of the level of action required, the stock abundance, and the regulatory area. Market factors such as participation levels and willingness to pay for the opportunity to sport fish for halibut will also influence future harvest potential and will need to be taken into consideration when shaping a regulatory strategy.

Determining the best management measure, or combination of measures, to use should be based on the best, most current information available. For this reason, it is preferable to make a list of tools available to managers from which a manager may select one or more of the tools listed. This is the approach used to manage the recreational chinook salmon fishery in southeast Alaska. However, as noted above, final rule making may preclude such flexibility. As such, the measures may need to be periodically evaluated by the Council.

Table 6.19. Estimated harvest reduction by implementing annual limits on anglers fishing from charter vessels

ANNUAL LIMIT	**HARVEST REDUCTION (PERCENT)**	
	2C	**3A***
4	39	25
6	18	15
7	8	10
10	2	6

* The original calculations were done for nonresidents only. The assumption was made that residents fishing from charter vessels in 3A had the same harvest patterns as nonresidents. Therefore, the harvest reductions in 3A were increased by 1/3 to account for reductions in resident harvest also. Since less than 5% of charter clients in 2C are residents, no changes were made to the original harvest reduction estimates.

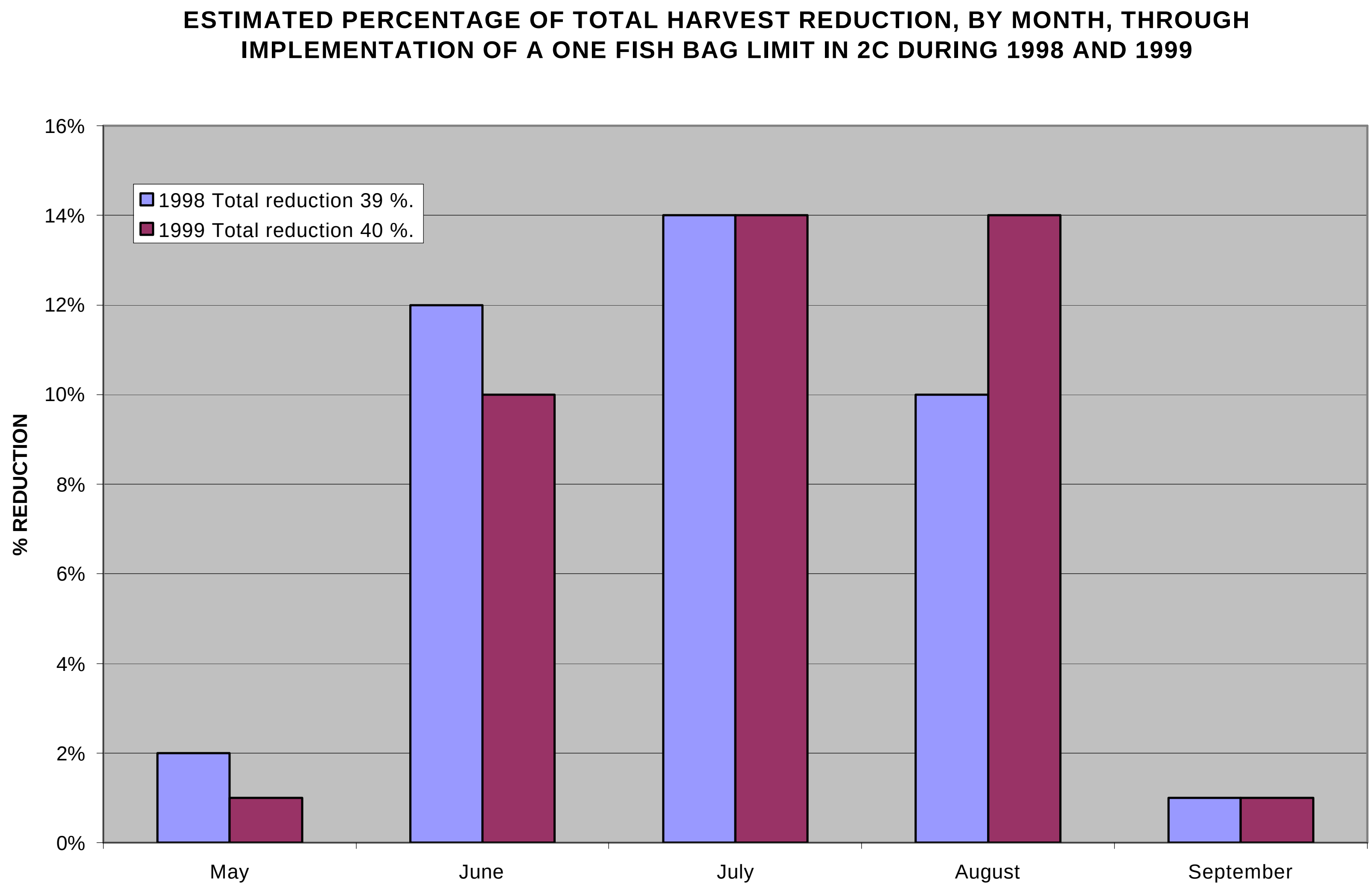

Figure 6.5. Estimated percentage of total harvest reduction, by month, obtained by implementing a 1 fish bag limit in Area 2C, 1998 and 1999.

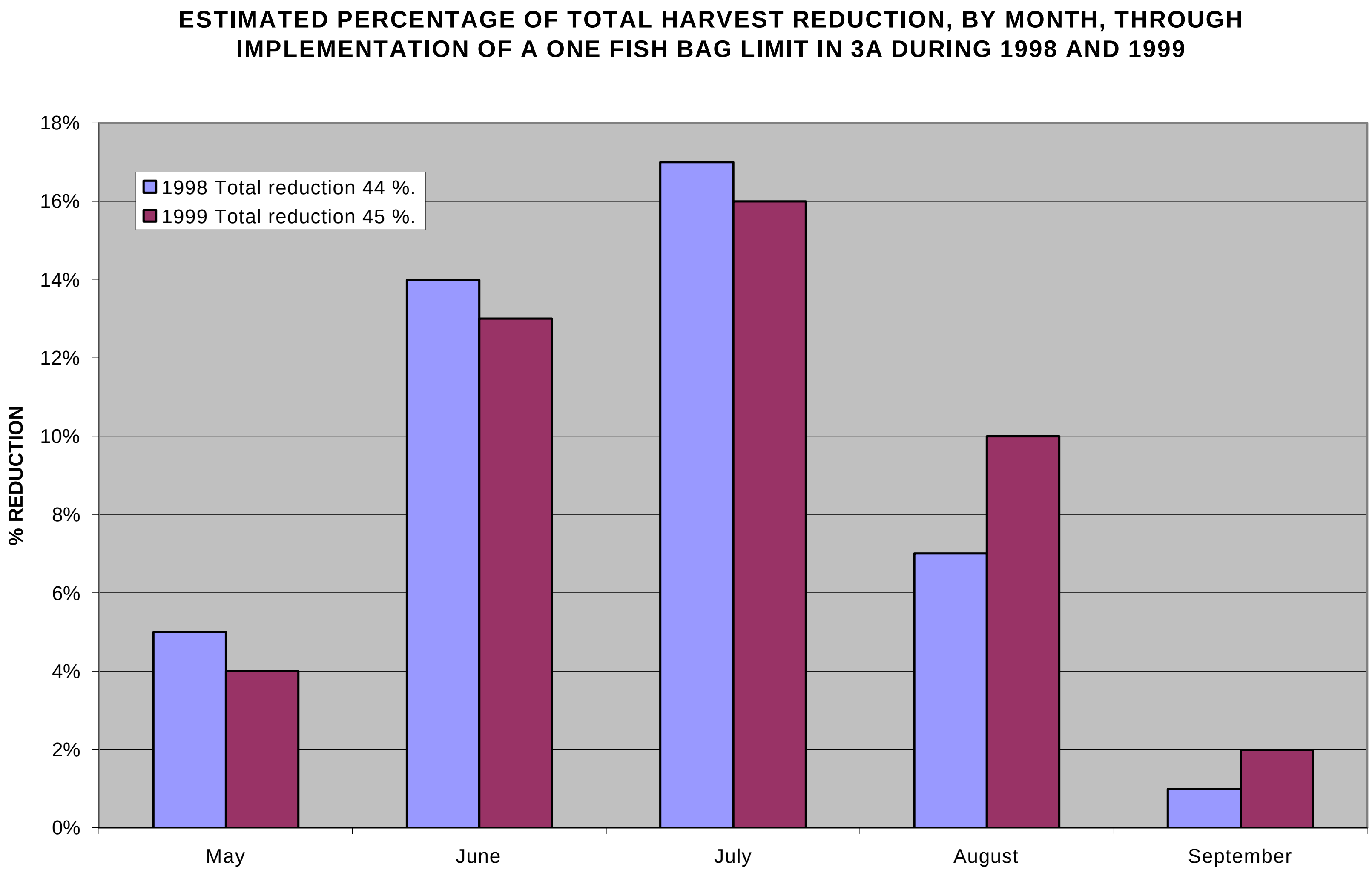

Figure 6.6. Estimated percentage of total harvest reduction, by month, obtained by implementing a 1 fish bag limit in Area 2C, 1998 and 1999.

Framework management matrices depicting how the above management measures could be employed to manage a GHL or other allocation scheme for Areas 2C and 3A are depicted in Figures 6.7 and 6.8, respectively. These matrices are "sample" implementation strategies that show how various measures could be employed to reduce harvest in both areas. They are presented as placeholder frameworks to facilitate discussion, and are not intended as "the" proposed implementation strategy. Different matrices are provided for Areas 2C and 3A to account for differences in fishery performance in the two areas and to remind the public of the Council's ability to select different management measures in each area.

The potential harvest reductions presented in the matrix were calculated based on performance statistics of the halibut charter fishery during 1998 and 1999. Various factors, such as changes in halibut stock abundance, local area plan management, and changes in fleet behavior or clientele to imposed regulations, could affect the realized harvest reduction potential. For example, if halibut stock size was to decrease as speculated by the IPHC, effects of an annual limit or reduced daily bag limit are likely to be less than noted. Also, the management measures in each harvest reduction category may not be independent and therefore may not be additive.

Structure and Stability of the Management Objective for Harvest: A management objective for harvest should be stated in such a manner as to take into account the management precision of the assessment program. Stating the objective in the form of a range can provide for this acknowledgment. In addition, the more stable the management objective for harvest is the more likely the objective will be achieved. An annually shifting allocation has a high probability of requiring annual adjustments that are small enough to be beyond the precision of the management tools and ability to evaluate.

Timing of Implementation

Currently the ADFG provides the IPHC a preliminary estimate of that year's sport harvest in December based on logbook, creel survey, and port sampling information. The IPHC uses this estimate to project the harvest in the sport fishery for the next year. At the end of the next year, ADFG provides a final estimate of the previous year's sport fishery based on the results of the statewide mail survey.

NMFS identified that perhaps as little as six weeks may be needed (dependent upon staff availability) between public notice of charter harvests exceeding the GHL (e.g., December) and public notice to implement triggered management measures for a non-discretionary decision by the NMFS Regional Administrator (mid-February). Such a process would utilize a closed framework action based on an analysis of the proposed action (this EA/RIR/IRFA).

Alternatively, an open frameworked action whereby the RA exercises his discretion in selecting to implement a triggered management measure(s) may be as long as 4 months (e.g., April). In this case more time is needed for notice for public comment and final notice (the 30 day comment may be waved to reduce the time needed to 3 months) (March). A trailing regulatory amendment may be required in the open framework process if sufficient time has rendered the analyses obsolete to the time of his decision or staff must develop the rationale for his decision in choosing from numerous measures.

The Council has intended a desire to minimize disruption to the charter industry. In this case a one year notice may be desirable. In this case, triggering a management measure the following season may meet industry needs. This has the benefit of basing management measures on final estimates of charter harvest.

HARVEST REDUCTION REQUIRED	MANAGEMENT TOOL	ESTIMATED HARVEST REDUCTION POTENTIAL
< 10%	PROHIBIT HARVEST BY SKIPPER AND CREW	3%
10 – 20%	PROHIBIT HARVEST BY SKIPPER AND CREW	3%
	ANNUAL LIMIT OF 6 FISH	18%
	TOTAL	21%
20 – 30%	PROHIBIT HARVEST BY SKIPPER AND CREW	3%
	ANNUAL LIMIT OF 6 FISH	18%
	REDUCE BAG LIMIT TO ONE FISH/DAY IN AUGUST	12%
	TOTAL	33%
30 – 40%	PROHIBIT HARVEST BY SKIPPER AND CREW	3%
	ANNUAL LIMIT OF 4 FISH	39%
	TOTAL	42%
> 40%	PROHIBIT HARVEST BY SKIPPER AND CREW	3%
	ONE FISH/DAY BAG LIMIT FOR ENTIRE SEASON	40%
	TOTAL	43%

Implementation of management tools to achieve harvest reductions from 0 – 20% could take place the season following the overage.

Implementation of management tools to achieve harvest reductions above 20% could take place one year following the overage to give charter industry more time to adjust.

Figure 6.7. Management measure matrix for reducing harvest in Area 2C.

HARVEST REDUCTION REQUIRED	MANAGEMENT TOOL	ESTIMATED HARVEST REDUCTION POTENTIAL
< 10%	PROHIBIT HARVEST BY SKIPPER AND CREW	8%
10 – 20%	PROHIBIT HARVEST BY SKIPPER AND CREW	8%
	ANNUAL LIMIT OF 7 FISH	10%
	TOTAL	18%
20 – 30%	PROHIBIT HARVEST BY SKIPPER AND CREW	8%
	ANNUAL LIMIT OF 4 FISH	25%
	TOTAL	33%
30 – 40%	PROHIBIT HARVEST BY SKIPPER AND CREW	8%
	ANNUAL LIMIT OF 4 FISH	25%
	REDUCE BAG LIMIT TO ONE FISH/DAY IN AUGUST	8%
	TOTAL	41%
> 40%	PROHIBIT HARVEST BY SKIPPER AND CREW	8%
	ONE FISH/DAY BAG LIMIT FOR ENTIRE SEASON	45%
	TOTAL	53%

Implementation of management tools to achieve harvest reductions from 0 – 20% could take place the season following the overage.

Implementation of management tools to achieve harvest reductions above 20% could take place one year following the overage to give charter industry more time to adjust.

Figure 6.8. Management measure matrix for reducing harvest in Area 3A.

Enforcement

Enforcement issues: Enforcement is a key component of any fishery harvest management scheme. The NMFS, USCG, ADPS, and ADFG all report that they do not have enforcement programs specifically directed at the recreational charter fishery. Instead, enforcement occurs on an opportunistic basis. All agencies agreed that some level of additional enforcement would be needed under a GHL system, depending upon the allocation and implementation scheme adopted. Also, the decision to allocate additional enforcement to this program would properly entail an evaluation of the public interest in doing so, versus the trade offs in doing less enforcement somewhere else.

Staff discussed GHL enforcement issues, especially the implications of activating the various measures like line, bag, and trip limits. Although a state enforcement officer was not present, the other agencies essentially reported that additional enforcement resources would not be forthcoming to support this program.

Having said that, there are characteristics of the recreational charter fishery that suggest a different and lesser level of enforcement may be needed to ensure an adequate level of compliance with the program. Several characteristics of the fishery differentiate it from other fisheries and work to the advantage of regulators:

a. The recreational charter boat fishery operates in the public eye. Requiring operators to prominently post GHL control measures like bag limits and line limits onboard charter boats would help to promote compliance. The state could further support this by requiring those businesses selling sport-fishing licenses to do the same.

b. The recreational charterboat fishery is highly competitive. And while there are some operations in isolated locations, many boats tie up and operate in close proximity to other charter boats. It is reasonable to expect that those operators who are following the rules would be quick to notice another operator seeking to "steal" customers by offering a better trip with higher bag or rod limits.

c. Charterboat operators are required to have a current Coast Guard license to operate. One of the conditions of the license requires the operator to comply with *all* federal regulations. Charter boat operators potentially risk losing their Coast Guard license if they violate federal fisheries regulations. It is reasonable to conclude that because of the nature of the Coast Guard license, inferring a trust and responsibility to the licensee, as well as the double jeopardy implications, charter boat operators would likely have a higher rate of compliance with GHL measures than might otherwise be expected.

These three factors, along with the current system of opportunistic enforcement may provide a level of compliance sufficient to ensure the GHL measures have the desired effect in controlling the fishery.

The Coast Guard has taken the position that where the above does not hold true, if there is sufficient public interest and concern in the conduct of the recreational charter fishery, it could respond by shifting effort from other areas to focus on the charter fleet. A highly publicized focus operation, of short duration, may have sufficient impact to raise compliance back up to an acceptable level, while only requiring a modest shift of enforcement effort. These operations could be done periodically through the region and season, under an overall strategy of raising compliance to an acceptable level. This approach is different from one that attempts to identify the law enforcement resources necessary to check all fishery participants or apprehend all violators.

In summary, staff discussed the importance of implementation and enforcement of whatever the Council chooses as its preferred action. Staff identified the lack of an appropriate and effective management measure to implement once an area GHL is reached. As a solution, ADF&G staff identified the following new management measures for Council consideration. A question arose as to whether the Council could take action on such measures that are not explicitly included in the public review analysis in February.